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Diffusion and System Change - A Case Study of Innovations in a Course Management System

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ABSTRACT

This case study in progress compares two stages of usage of a Course Management System at a private university: before a major functionality upgrade, and after. Here, we report the initial study of usage before the upgrade. It extends current research by taking into account prior use, and noting features (whether in the previous system or not) that attract new implementers. The focus of the study is on Perceived Characteristics of Innovations and management behaviors that facilitate effective implementation of system features. The instrument used by Van Slyke, Lou and Day will be used to study secondary adoption both before and after the upgrade, as described by Gallivan (2001). Results of the first phase of research will be available for presentation at the conference.

Keywords

COURSE MANAGEMENT SYSTEMS, DIFFUSION OF INNOVATIONS

INTRODUCTION

Course Management Systems are tools for packaging on-line courses as well as enhancing traditional courses. A CMS will typically have many features not used by most instructors. How do perceptions about CMS features affect adoption and utilization by professors?

While the Theory of Reasoned Action described by Fishbein and Azjen (1975) models adoption decisions using an unbounded list of ad hoc perceptions, and the Task-Technology Fit theory of Goodhue and Thompson (1995) contains only two, the theory of diffusion of innovations by Rogers (1962, 1973, 1983, 1995, 2003) posits that adoption decisions can be predicted by five constructs called Perceived Characteristics of Innovations. Research into the use of diffusion theory in information technology innovations by Moore and Benbasat (1991), Agarwal and Prasad (1997), Van Slyke et al. (2002) expanded the list of PCIs from Rogers' original five to eight.

OBJECTIVE OF THE STUDY

The primary objective of this study is to perform a longitudinal comparison of the chain of events from secondary adoption through actual usage, adoption of a new version, and the changes in usage that ensue. This longitudinal scope embraces secondary adoption, and reveals the effect on usage of changes in innovations as they are refined and presumably improved. We base our instrument on that used by Van Slyke et al. (2002). Our study's contribution is to track changes in the dynamics of diffusion as a software update cycle is performed, including actual measured usage as opposed to intention to use..

DIFFUSION THEORY

In over five editions, Rogers' *Diffusion of Innovations* (1962, 1973, 1983, 1995, 2003) has suggested, defended, popularized, and traced the progress of diffusion theory. To the question of how people make decisions about innovations they might use, Rogers' answer is that they use information that can be classified in a *limited* number of dimensions. If one determines a person's perceptions about the characteristics of a technology on those dimensions, it is possible to predict their adoption or non-adoption of the innovation. According to Rogers (2003, 15-16), the five dimensions are:

1. **Relative Advantage**: The degree to which an innovation is perceived as better than the idea it supersedes.
2. **Compatibility**: The degree with which an innovation is perceived as being consistent with the existing values, past experiences, and needs of potential adopters. *Interestingly enough, there is nothing mentioned about compatibility with existing technology*.
3. **Complexity**: The degree to which an innovation is perceived as difficult to understand and use.
4. **Trialability**: The degree to which an innovation may be experimented with on a limited basis.
5. **Observability**: The degree to which the results of an innovation are visible to others.

Valier et al. (2004) note modifications to the scale of Moore and Benbasat (1991) which added:

1. **Voluntariness**: The degree to which use of an innovation is entirely voluntary.
2. **Image**: The degree to which it is important to be seen using.
3. **Result Demonstration**: The ability to know the actual results of using.

The research stream so far focuses on attitudes and intentions. We expand that scope to include actual use.

Others including Gallivan (2001) have written reviews of additional literature that will be useful to the researcher wishing to understand how diffusion theory fits into the general field of IT usage study. Regarding Course Management Systems in particular, a study by Feeney (2001) suggests that actual usage information can be obtained automatically from a CMS.

Model Tested

While the DOI model is often described in static terms, the world is a dynamic place. Once primary adoption of a technology has taken place, one can reasonably expect secondary adoption to proceed as in the S-curve predicted by Rogers (2003, p 344) as:

- Early secondary adopters communicate with potential secondary adopters.
- Change agents communicate and convince more of their targets.
- Barriers such as complexity are reduced.

This research studies change. In our case, the university is in the process of implementing an upgraded version of WebCT.

The scale used by Van Slyke et al. (2002) will be used in a context that does not include major changes in the list of innovative features themselves, but in which their *availability* changes. The anticipated software upgrade should not only improve access to features due to better human engineering design, but free support personnel from repetitive administrative tasks so that they can have more time to function as change agents. This addresses the PCI of relative advantage. Primary sources of potential improvement in attitudes and increase in use are expected to be:

- Easier use of features, as refinements in the software become evident to potential users.
- Better timing of feature availability, as tighter integration with the campus IT system makes the CMS functional at times it is needed. Indeed, one instructor's personal Website contained a duplication of many materials he had also made available through WebCT, with the comment that "This is just to get you by until you can log in there."
- Increased availability of support staff, as tighter integration with the campus information system relieves them of repetitive tasks at the very time instructors are attempting to finalize their course materials and functions in WebCT.

RESEARCH METHODOLOGY

An initial analysis of CMS features was performed to identify a limited number of features suitable for a diffusion study. Data for this step were extracted from the campus IT system during the week of February 20, 2005. While 820 "classes" are listed in the university schedule, only 465 were analyzed for this study due to class size. Some classes were dropped from consideration because they had fewer than the 6 students identified by administration as the cutoff point for classes that will continue to be offered without question. Many of the dropped "classes" were actually provisions for practica, music lessons, internships, and directed study signups to accommodate students with sequencing problems as they approach graduation. Every class in the schedule had been set up with a WebCT account at the beginning of the semester.

Data collection during this phase consisted of inspecting WebCT class accounts. Figure 1 shows the results of this initial analysis.

Ideally, all areas would be studied. The construct method used for diffusion theory, however, requires almost 30 questions per technology being studied. We made the decision to study only the highest three to limit the survey instrument to roughly 100 questions. This presented a dilemma: While the first and second-most popular technologies being used were obviously providing information to students and online gradebooks, for the third-highest choice there were several candidates. Assignment submission was arbitrarily chosen because it was marginally preferred over other candidates by teachers (although in terms of frequency of use in classes it was not higher). So the areas chosen for study were:

- Distribution syllabi and supplementary materials such as PowerPoint presentations.

- Online gradebooks
- Assignment submission

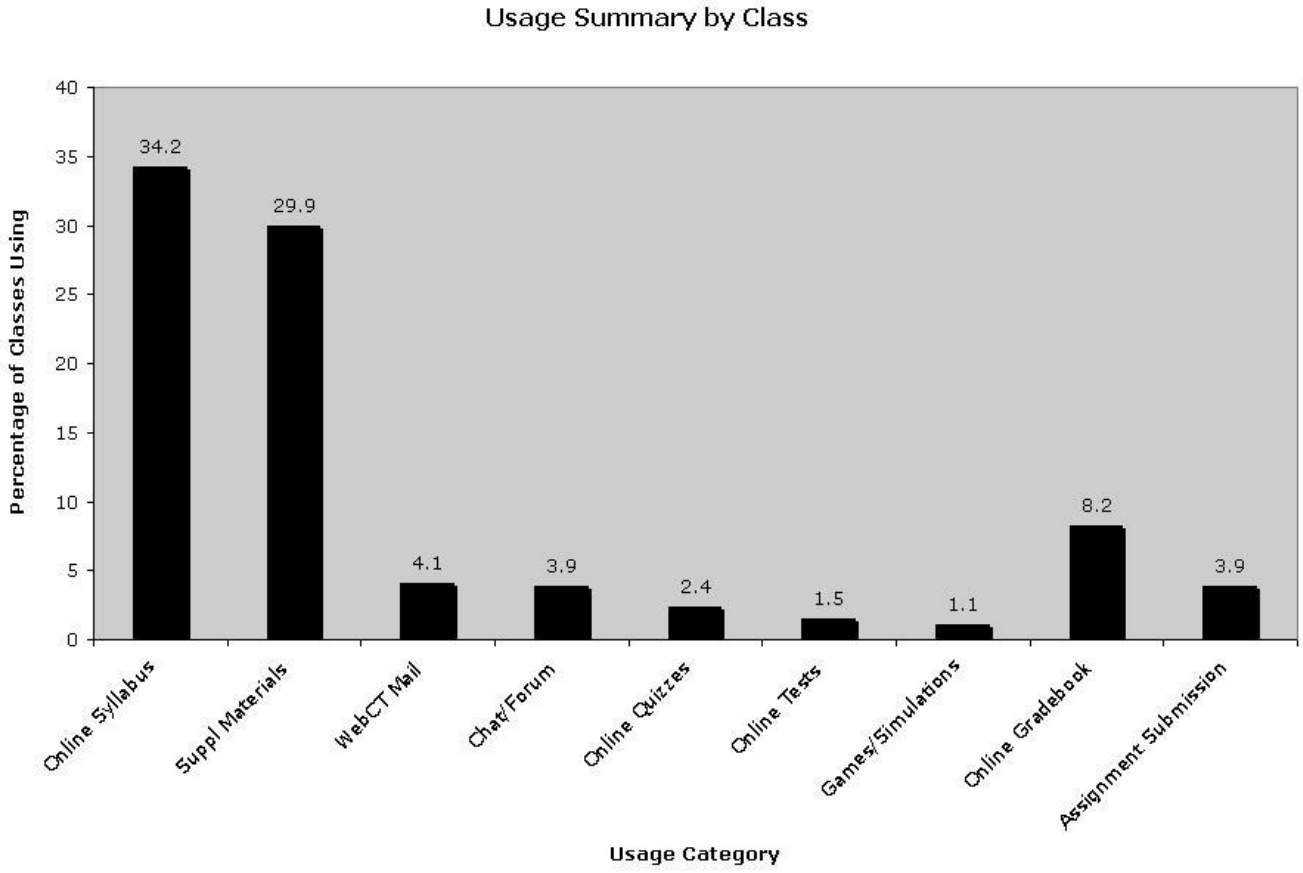

Figure 1. Baseline Usage Profile – by Classes

While usage by class is important to the student experience, this study focuses on use by instructors. Hence, a secondary analysis was performed in which each instructor who has at least one class qualifying under the six-student rule, was evaluated for the technologies they used. A total of 163 instructors had at least one qualifying class, and thus were included in the study. Since an individual instructor might have several classes and this analysis scored them as using any technology they used in any class, one might expect substantially higher percentage-use numbers. As Figure 2 illustrates, this was only modestly true. The general trend was the same as the by-class analysis.

At the time of this writing, it is not certain exactly what changes will be encountered as the software enters its next version. Two trends can be used to predict improvement, however:

1. WebCT has already promised to provide an "external database" for the next version. This is a key capability, since it will enable tight integration with the campus IT system – freeing the WebCT support staff at critical times. It may reasonably be presumed that some of the reason for low participation has been unavailability of help during the two weeks around registration, causing instructors who encounter minor problems to give up.
2. Some capabilities of WebCT have not been supported previously, because of the management overhead resulting from poor integration. For example, WebDAV uploading (which can be used effectively for publishing PowerPoint presentations) had not been implemented as of the date of this preliminary study.

For both reasons, we can reasonably expect improved attitudes in the future – and consequent increased usage.

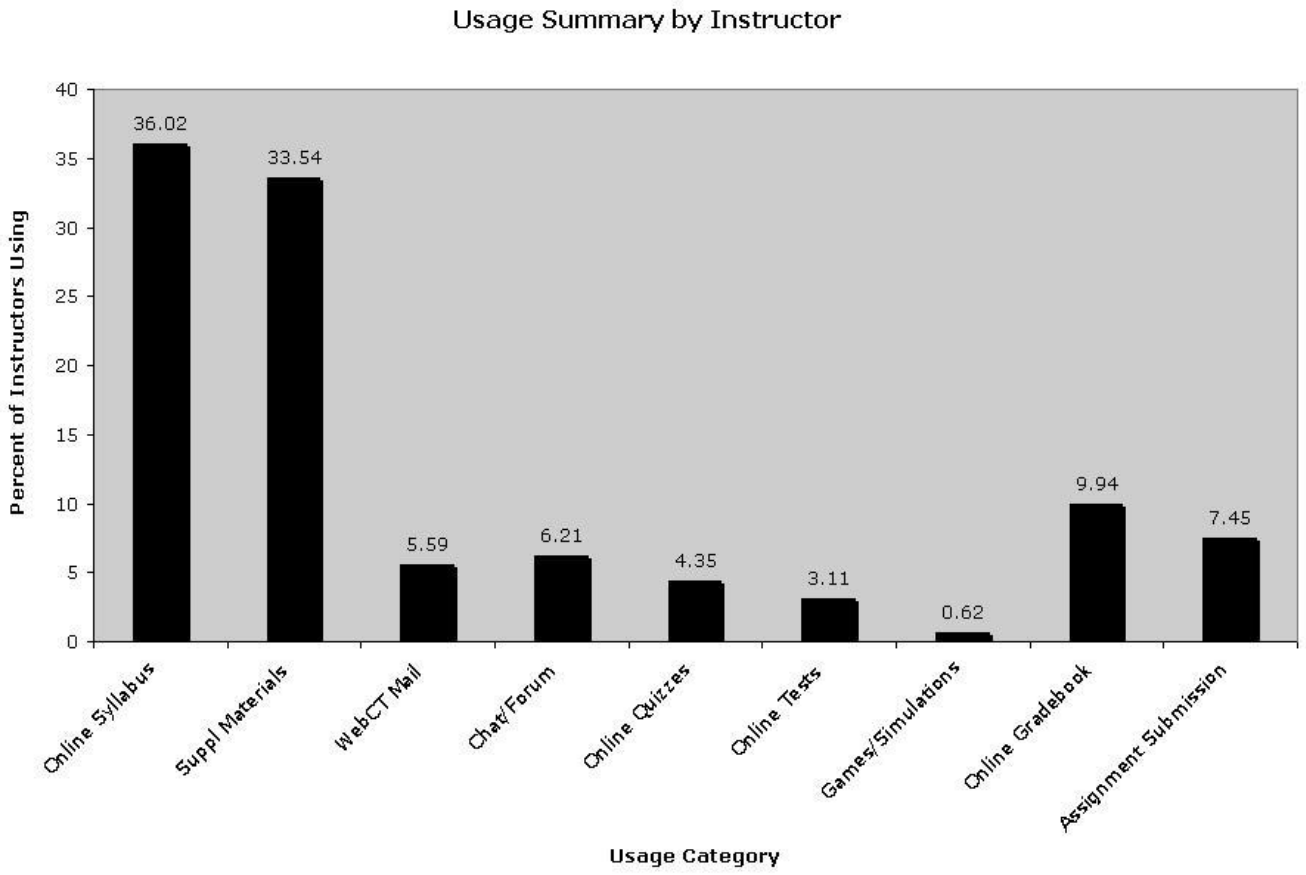

Figure 2. Baseline Usage Profile – by Instructor

Further Study

Pursuant to the goal of determining the affect of change in already-available technology, the following steps are envisioned in this ongoing project:

- Identification of technologies to be studied. Given the large number of questions per technology required for a diffusion study based on the Rogers model as implemented by Van Slyke et al. (2002), it will be necessary to severely restrict the number of technologies studied. Our current view, in light of the clusters found in the baseline analysis, is to use three:
    1. Use of WebCT to distribute materials to students.
    2. Use of WebCT to show individuals their scores in the instructor's gradebook.
    3. Use of WebCT to provide a mechanism for turn-in of written assignments.
- Administration of a survey drawn from that of Moore and Benbasat (1991). Statistical analysis will compare PCI scale scores from that survey with actual use. Although the identities of respondents will be known to the researchers for purposes of matching to the usage analysis, only totals and aggregate statistical measures will be revealed and reported. We will report results from this phase at AMCIS in August.

- Repeat of the earlier steps in the Fall of 2005, after the new version of the software is installed and brought online during the summer.
- Comparison of both PCI scale scores and usage factors before and after the change.

LIMITATIONS

The institution has no control over the exact improvements to be implemented by WebCT. Informal advance information from WebCT indicates a strong focus on usability: Tools at your fingertips, Easily accomplish **real world** tasks, Efficiently complete repetitive tasks, Consistency, and Simplicity.

In diffusion studies, one concern is the extent to which adoption is voluntary. The present director of the CMS project is firmly committed to voluntarism, and went so far as to prohibit revelation of comparative usage between departments in the arrangements for data availability in this study.

The institution studied has relatively few multi-section classes simply because of its scale. So while the small size makes it possible to do a full study of classes offered rather than a sample, certain types of analysis such as whether diffusion occurs more within disciplines or not, are made more difficult. Casual observation of the data suggests that in this particular organization's culture, diffusion occurs largely among people interested in the technology and not among those who wish to achieve a particular end. There appeared to be no case where a department or school mandated use of WebCT across all sections of a class or program – with the exception of a single program being advertised as available by distance learning.

Causuality will remain a question. If there are increases in usage are they due to classic diffusion between adopters, improvements in relative advantage, or increased support? It is our contention that the interactions between these factors are probably too complex to study given the dynamic nature of the technologies being studied, and not relevant to the primary concern of managers: whether the funding for the CMS project is justified.

CONCLUSION

This study is expected to empirically demonstrate the relationship between changes in PCIs and actual use. Ultimately, this can be used by managers to know based on survey data, whether stated interest in PCIs indicates actual likelihood of adoption for updated technologies.

It is too early in our study to make concrete recommendations for future study. One might suggest, however, that in a larger setting it would be possible to consider the effect of management interventions such as enhanced training programs. We plan to report our empirical findings in a later paper.

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